PATENT SPECIFICATION

Application Date: May 26, 1939. No. 15663/39. 529,783

Complete Specification Left: May 14, 1940.

Complete Specification Accepted: Nov. 28, 1940.

PROVISIONAL SPECIFICATION

Improvements in the Control of Variable Pitch Airscrews

We, BLACKBURN AIRCRAFT LIMITED, a Company organised under the Laws of Great Britain, of Seaplane Base, Brough, near Hull, East Yorkshire, and JOHN BUTLER EDLINGTON JOHNSON, a British Subject, of Coniston, West Ella Road, Kirkella, East Yorkshire, do hereby declare the nature of this invention to be as follows:—

This invention relates to variable pitch airscrews of the type comprising a governor for determining the blade pitch, a spring controlling the operation of the governor, and means operable by the pilot for varying the loading of the spring and hence the pitch of the blades.

Various methods have been devised for controlling the tension in the spring, e.g. mechanical control of a deflecting plunger, by cable and pulley or by a hydraulic piston. All these methods suffer from the disadvantage of lost motion or sticking so that it is extremely difficult to control the pitch of a remotely positioned airscrew with sufficient accuracy.

The invention provides an electric motor connected through gearing to a plunger or the equivalent for applying the loading to the spring, the motor having an interrupted slip ring to cause it to stop when the deflection of the plunger has reached the value corresponding to a preselected adjustment of the blades.

It will be appreciated that the arrangement may be such that the spring causes the governor to vary the pitch of the blades in such a way as to maintain a constant engine speed determined by the loading of the spring, or alternatively it may be such that the governor sets the blades to a definite pitch determined by the loading of the spring.

The motor is preferably provided with a number of interrupted slip rings on a control drum, the gaps in the rings being staggered. Lines connecting the slip rings together and to the motor are provided on opposite sides of the gaps, these lines including field windings one for rotating the motor in one direction and the other for rotating it in the other. A rotary switch completes a circuit from a battery through the slip rings selected by the switch. On connecting the switch to any slip ring, the motor is started so as to cause the control drum to turn, the motor stopping when the brush co-operating with the slip ring reaches the gap therein. Conveniently three slip rings may be provided, one corresponding say to 2400 r.p.m., the next to 2650 r.p.m. and the third to the take-off engine speed.

The slip rings may be controlled by a series of push buttons, switches or notches on a lever, the buttons, switches or notches being marked in the number of engine revolutions to which the motor stopping position corresponds. In multi-engine machines it is desirable to synchronise accurately the positions of the deflected springs so that the engine revolutions per minute may also be synchronised. In order to effect this "inching" controls are provided. These may take various standard forms, one of which is by the provision of a switch which allows the gap in the interrupted ring to be bridged during the period the switch is held closed, this resulting in the motor moving forward during this period. The current may be passed through the motor coils in the reversed sense when a second "inching" button is closed, resulting in the motor moving in backward direction during the closed switch period. The system is designed to operate from a 12 or 24 volt battery.

Dated this 26th day of May, 1939.

BREWER & SON,
33, Chancery Lane, London,
Patent Agents for the Applicants.

COMPLETE SPECIFICATION

Improvements in the Control of Variable Pitch Airscrews

We, BLACKBURN AIRCRAFT LIMITED, a Company organised under the Laws of Great Britain, of Seaplane Base, Brough, near Hull, East Yorkshire, and ELSIE

JOHNSON, a British Subject, of Coniston, West Ella Road, Kirkella, East Yorkshire, legal representative of JOHN BUTLER EDLINGTON JOHNSON, deceased, a British Subject, late of Coniston, West Ella Road, Kirkella, East Yorkshire, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to variable pitch airscrews of the type comprising a governor for determining the blade pitch, a spring controlling the operation of the governor, a plunger or the equivalent serving as an abutment for the spring and control means operable by the pilot to displace the plunger and thereby vary the loading of the spring and hence the pitch of the blades.

Various methods have been devised for controlling the tension in the spring, e.g. mechanical control of a deflecting plunger, by cable and pulley or by a hydraulic piston. All these methods suffer from the disadvantage of lost motion or sticking so that it is extremely difficult to control the pitch of a remotely positioned airscrew with sufficient accuracy.

The invention provides a variable pitch airscrew of the type described, in which the pilot's control means comprise an electric motor, reduction gearing for displacing the plunger on operation of the motor, a plurality of interrupted slip rings on a rotary carrier driven by the motor and a selector switch for connecting any one of the slip rings at will in the circuit supplying current to the motor. By selecting a given slip ring therefore, the pilot can cause the motor to rotate and displace the plunger to a definite position determined by the position of the gap in the slip ring.

It will be appreciated that the arrangement may be such that the spring causes the governor to vary the pitch of the blades in such a way as to maintain a constant engine speed determined by the loading of the spring, or alternatively it may be such that the governor sets the blades to a definite pitch determined by the loading of the spring.

One practical embodiment of the invention will now be described in greater detail, by way of example, with reference to the accompanying drawings, in which:—

Fig. 1 is a side elevation of the reduction gearing associated with the motor.

Fig. 2 is a section through the governor mechanism of the airscrew, and

Figs. 3 and 4 are circuit diagrams, showing the effect of moving the selector switch to two different positions, the slip rings on the control drum being shown in a developed view in these Figures.

The governor mechanism is of known type, and consequently need only be briefly described. In Fig. 2, 10 represents the controlling spring, 11 the governor weights, 12 the displaceable plunger and 13 a hydraulic valve controlling the pitch of the blades in such a way as to maintain a constant engine speed.

In the arrangement illustrated the plunger 12 is movable into three definite alternative positions, corresponding respectively to 2400 r.p.m., 2650 r.p.m. and the take-off engine speed, the valve 13 responding, under the control of the governor weights 11, to set the blades to a pitch such that the engine revolutions are maintained at the value corresponding to the setting of the plunger.

The setting of the plunger 12 is controlled by an electric motor 14 (Fig 1), the spindle of which carries a worm 15 meshing with a worm wheel 16 on a shaft 17. The latter is connected by gears 18, 19 to a shaft 20 carrying a control drum 21. The shaft 20 is connected by reduction gears 22, 23 to the control shaft 24. The latter carries a toothed quadrant 25 (see Fig. 2) meshing with rack teeth on the plunger 12, so that rotation of the motor will effect controlled adjustment of the position of the plunger.

On the control drum 21 are carried five slip rings A, B, C, D, E cooperating respectively with brushes *a*, *b*, *c*, *d*, *e*. Each of three slip rings A, B, C, is interrupted by two gaps A^1, A^2, B^1, B^2 and C^1, C^2 respectively, the gaps being staggered as shown in Figs. 3 and 4, while the slip rings D and E are continuous. The portions of the slip rings A, B and C to the left of the gaps A^2, B^2, C^2 in Fig. 3 are connected to one another and to the slip ring E by a line 27, while the other portions of the slip rings A, B and C are connected to each other and to the slip ring D by a line 28.

The brushes *a*, *b*, *c* are connected by lines 29, 30, 31 respectively to the contacts 32, 33, 34 of a rotary selector switch S, the contact arm 35 of which is connected by a line 36 to one pole of a battery 37. The other pole of the battery is connected by a line 38 to the armature of the motor 14. The brush *d* is connected by a line 39 to the forward field winding F of the motor and thence by a line 40 to the opposite side of the armature. The brush *e* is connected by a line 41, through the reverse field winding F^1 of the motor to the line 40.

In Fig. 3 the control drum 21 is shown in the position which it occupies when the selector switch S has been moved to select the slip ring A which corresponds to 2400 r.p.m., the motor having stopped when the brush *a* has reached the gap A^1 in the slip ring A, and the plunger 12 having been set to the appropriate position. If now the pilot wishes to adjust the pitch of the propellor to the position appropriate to an engine speed of 2650 r.p.m. he moves the arm 35 of the selector switch S one step to the right so as to make contact with the contact 33. Current then flows from the battery 37 through the selector switch and line 30 through the portion of the slip ring B to the right of the gap B^2 and through the line 28, slip ring D, line 39, forward field winding F and the armature of the motor 14 and back to the battery. The motor then rotates the control drum 21 in a forward direction until the brush *b* comes opposite the gap B^1 in the slip ring B when the motor stops. The plunger 12 has now been adjusted to the position appropriate to 2650 r.p.m. This state of affairs is illustrated in Fig. 4.

If now the pilot wishes to set the blades to the position appropriate to take-off the contact arm 35 is moved on to contact with the contact 34. The current is then established through the right-hand portion of the slip ring C, the line 28, slip ring D and forward field winding F as before, and the motor is rotated in a forward direction until it is brought to a stop owing to the brush *c* reaching the gap C^1 in the slip ring C, the plunger 12 being moved forward to the position appropriate to the take-off.

If, on the other hand, starting from the position shown in Fig. 4, the pilot should wish to alter the pitch of the blades to the position corresponding to 2400 r.p.m. the contact arm 38 of the selector switch S is moved back into contact with the contact 32. The current then flows through the left-hand portion of the slip ring A, line 27, slip ring E and reverse field winding F^1. The motor then rotates in the reverse direction and stops when the control drum 21 has been moved back into the position shown in Fig. 3, in which the brush *a* occupies the gap A^1 in the slip ring A and the plunger 12 has been returned to the position corresponding to 2400 r.p.m.

In multi-engine machines it may be desirable to synchronise accurately the positions of the deflected springs associated with the several airscrews, so that the engine revolutions per minute may also be synchronised. In order to effect this, "inching" controls may be provided. These are shown in Figs. 3 and 4 as consisting in inching switches I, I^1, which can be closed to bridge the gap in the interrupted slip ring during the period for which the respective inching switch is held closed. As will be seen, when the inching switch I is closed current passes through the forward field winding F to give a fine forward adjustment in the position of the control drum while when the inching switch I^1 is held closed the current flows through the reverse field winding F^1 to give a fine reverse adjustment in the position of the control drum.

The system illustrated is designed to operate from a twelve or twenty-four volt battery.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A variable pitch airscrew of the type described, in which the pilot's control means comprise an electric motor, reduction gearing for displacing the plunger on operation of the motor, a plurality of interrupted slip rings on a rotary carrier driven by the motor and a selector switch for connecting any one of the slip rings at will in the circuit supplying current to the motor.

2. Apparatus as claimed in Claim 1, in which the reduction gearing consists of a number of stages, the carrier for the slip rings being mounted on a shaft carrying one of the intermediate gears thereof.

3. Apparatus as claimed in Claim 1 or Claim 2, having inching switches for bridging the gap in the selected slip ring for the purpose of effecting forward or reverse movement of the motor to obtain a fine adjustment in the setting of the plunger.

4. Variable pitch airscrews fitted with control means substantially as described herein with reference to the accompanying drawings.

Dated this 14th day of May, 1940.

BREWER & SON,
33, Chancery Lane, London,
Patent Agents for the Applicants.

Leamington Spa: Printed for His Majesty's Stationery Office, by the Courier Press.—1940.

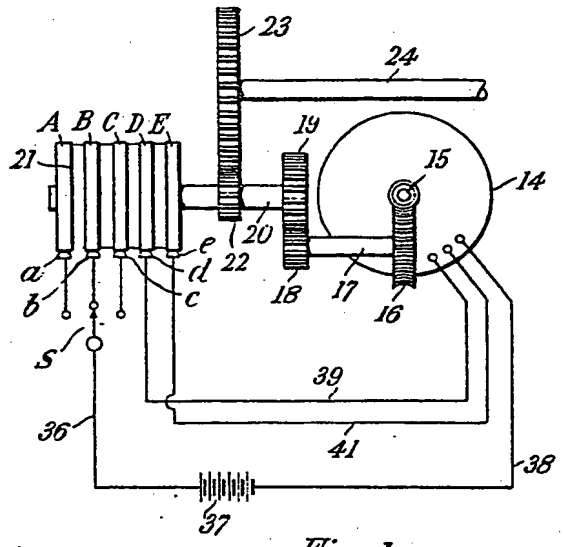


Fig. 1.

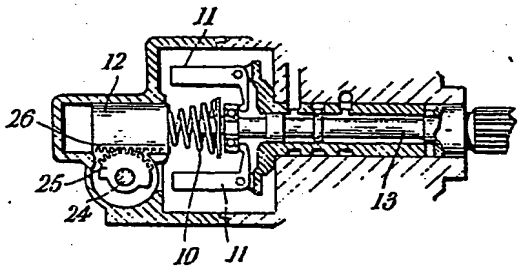


Fig. 2.

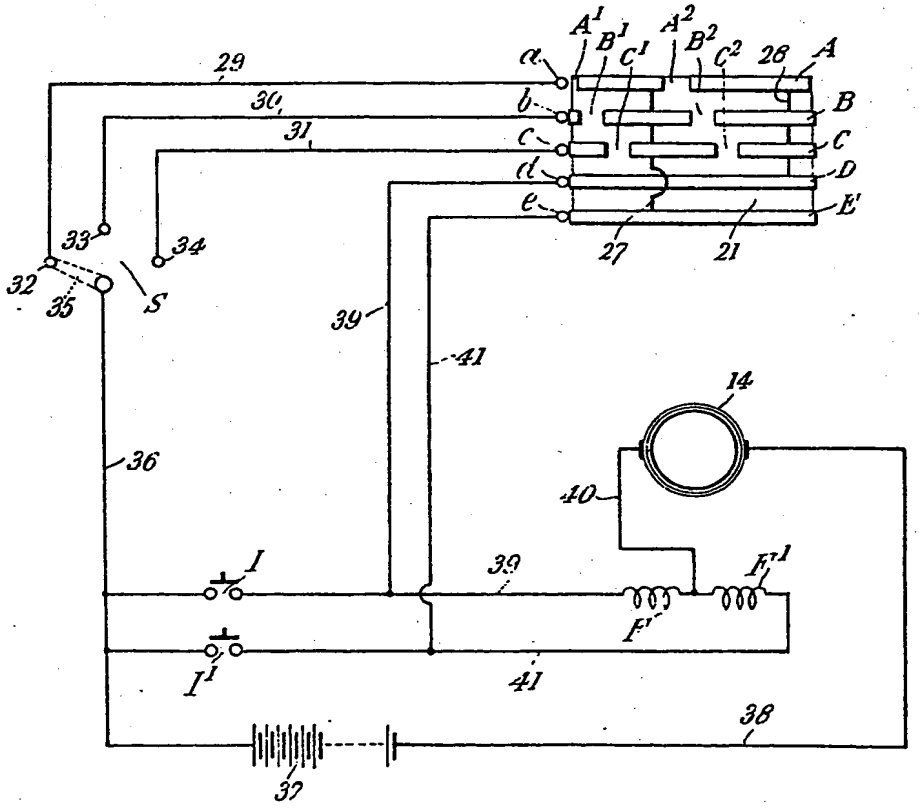


Fig. 3.

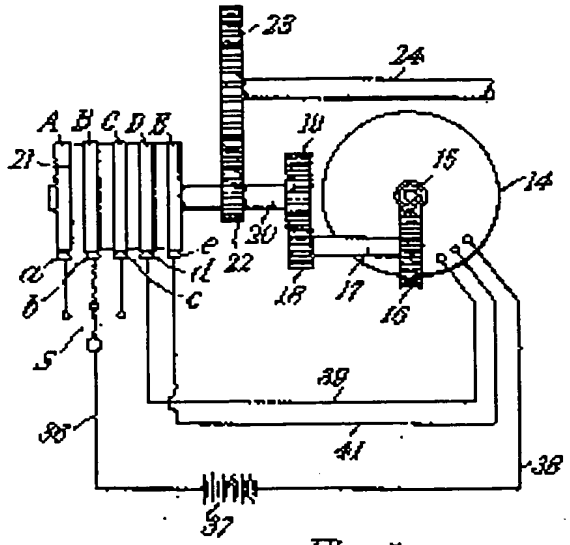


Fig. 1.

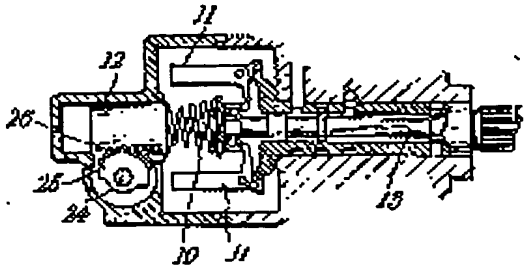


Fig. 2.

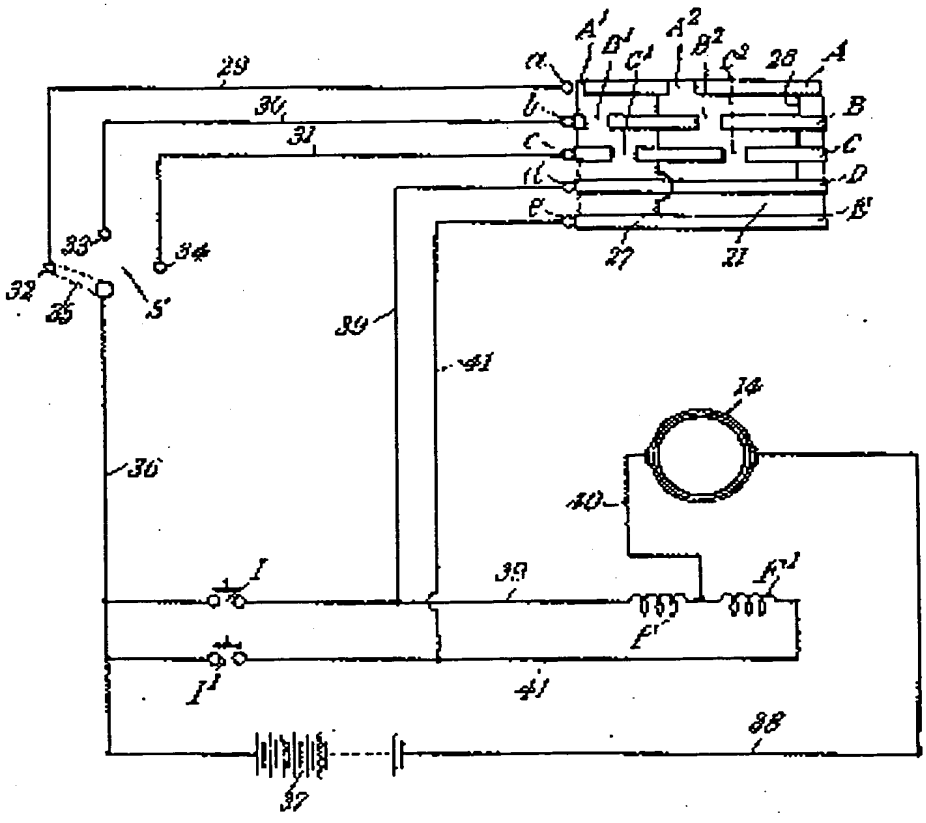
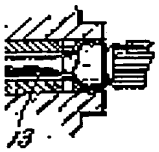


Fig. 3.

SHEET 1



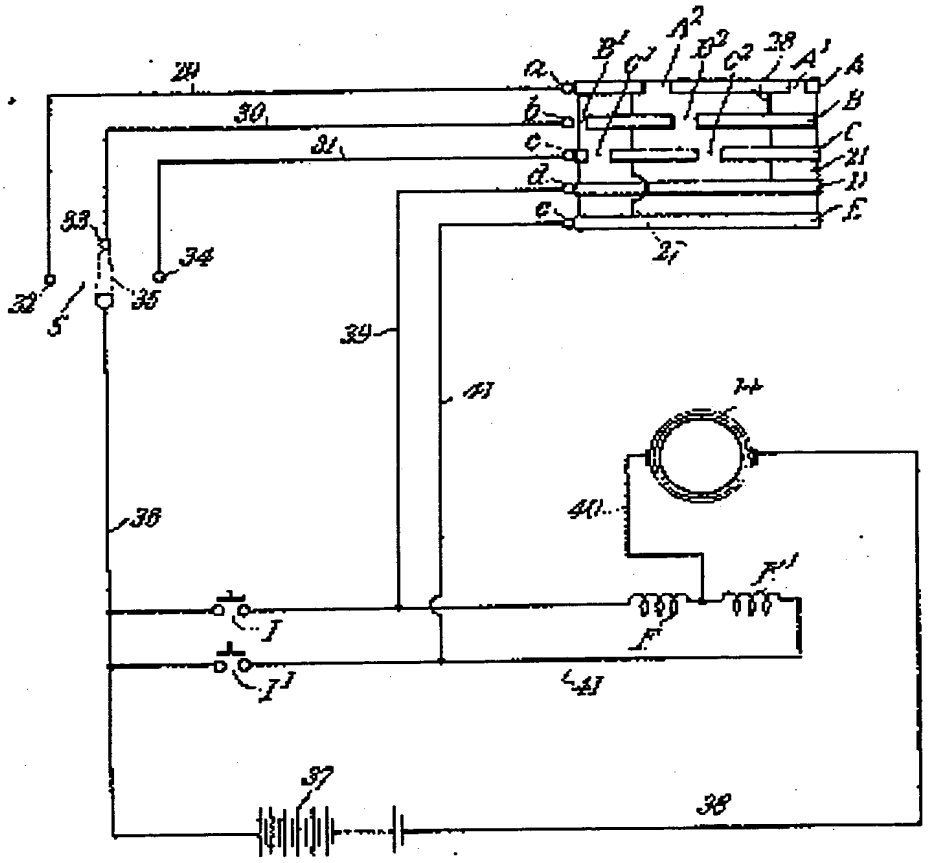
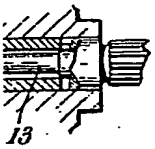


Fig. 4.

Malby & Sons, Photo-Lith

SHEET 1



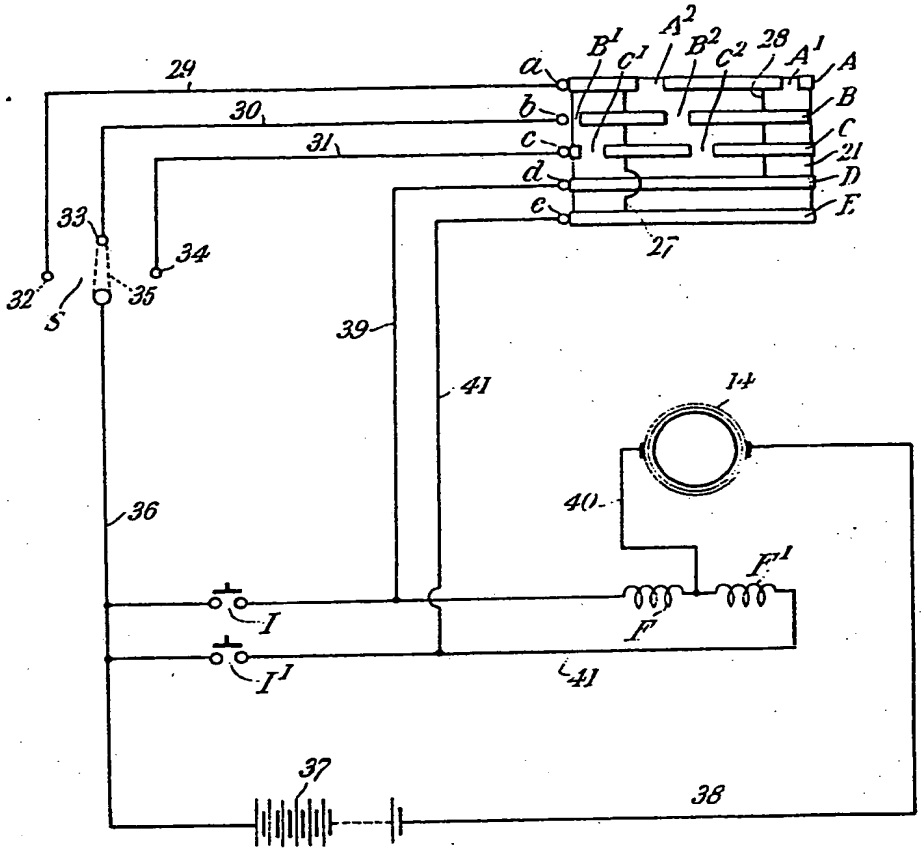


Fig. 4.

Malby & Sons, Photo-Lith

529,783 COMPLETE SPECIFICATION

2 SHEETS

SHEET 1

SHEET 2

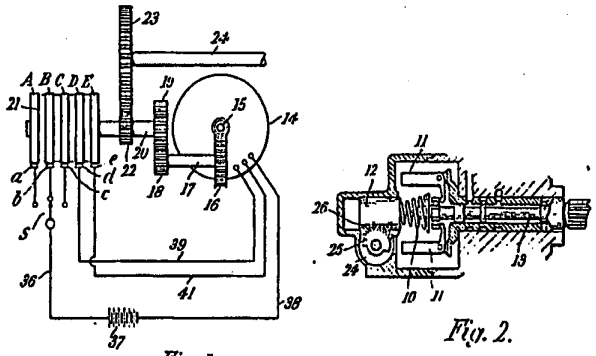


Fig. 1.

Fig. 2.

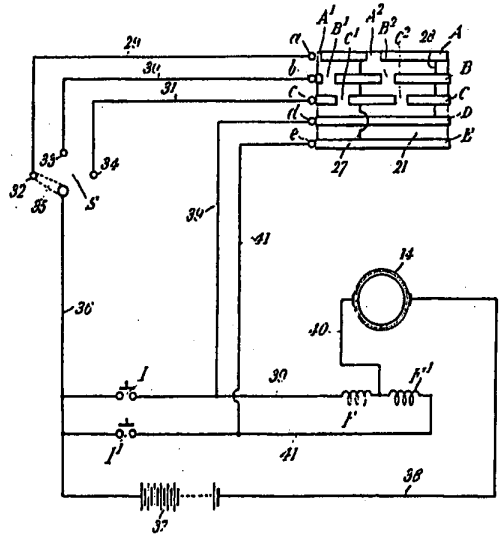


Fig. 3.

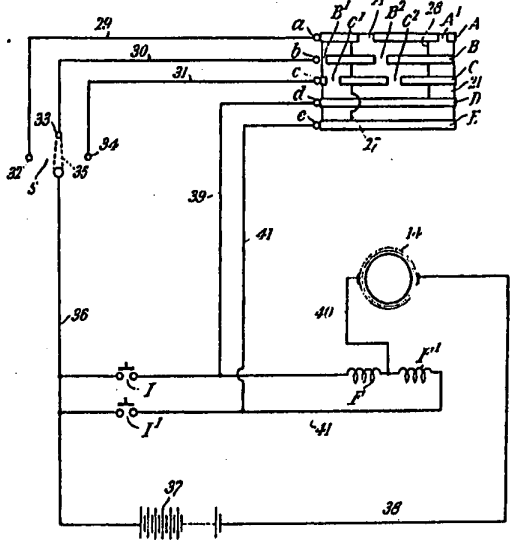


Fig. 4.

Malby & Sons, Photo-Lith

529,782 COMPLETE SPECIFICATION

SHEET 1

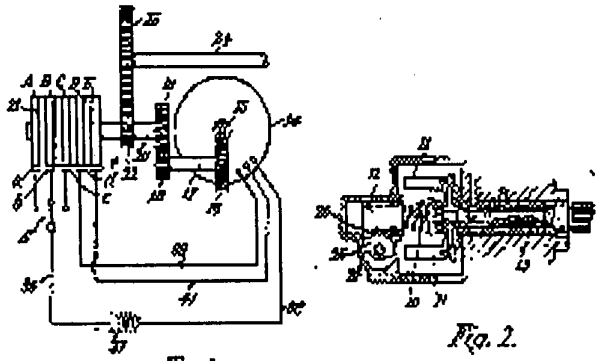


Fig. 1.

Fig. 2.

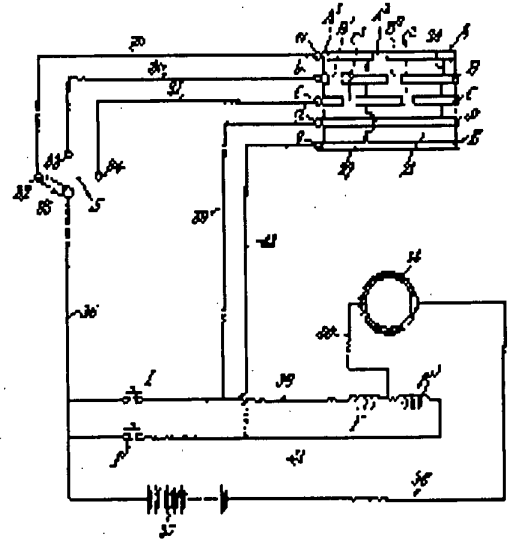


Fig. 3.

SHEET 2

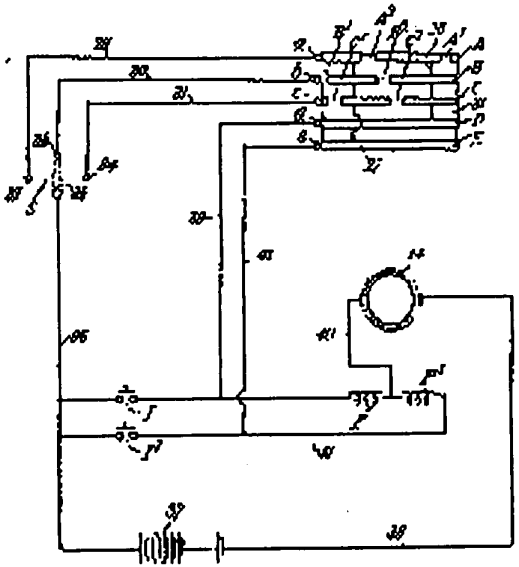


Fig. 4.